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Contribution of Tomodensitometry in the Management of Cranio-Encephalic Trauma in Chme Luxembourg

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Abstract **Original Research Article**

Goal: We initiated this work with the aim of evaluating the cost and benefit of computed tomography in the management of craniocerebral trauma. ***Patients and Methods***: This was a prospective study of 340 head trauma patients who underwent a brain scan at Luxembourg Hospital during the study period from April 1 to December 1, 2019. ***Result:*** During this study we collected 340 cases of cerebral CT scans for cranio-encephalic trauma, ie 10.36%. The average age of our patients was 22.14 years. Male dominated the study with a sex ratio of 2H / 1F. Pupils and students were the most affected socio-professional layer, ie 44.4% of cases. The most frequent aetiology was road accidents, ie 83.8% of cases. The symptoms that prompted the request for the CT scan were dominated by headache, ie 93.2% of cases. The time to complete the CT scan was between the 2nd and 6th hour after their admission to the ward. The cost of the brain scan of these patients amounted to 15, 300,000 FCFA (45,000F per person). On CT, a predominance of bone fractures was noted, ie 37.6% of cases. Intracerebral lesions were dominated by edema-hemorrhagic contusions (6.5%). ***Conclusion:*** The CT scan is the primary examination of an emergency head trauma patient. It provides a better understanding of the different types of cranio-encephalic injuries of traumatic origin, their topography and their importance. But the high cost of the scanner in our health facilities and the lack of an emergency aid service are factors that delay the urgent care of trauma patients.
Keywords: Head trauma, CT, cost.

Patients and Methods

This was a prospective study over a period of 9 months (from April 1 to December 1, 2019) carried out in the radiology and medical imaging department of the Luxembourg hospital center.

It involved 340 cases of both sexes coming for head trauma who received a brain scan during the study period.

The study variables were: socio-demographic data (age, sex, profession, residence, marital status) and economic data (means of transport and the cost of care which was the responsibility of the patients), clinical data (initial or secondary loss of consciousness, clouding of consciousness and coma) and data relating to the results of CT (lesions of the scalp, bones, edema-hemorrhagic contusion, sub- and extra-dural hematomas, hematomas intra-cerebral, axonal lesions, pneumocephaly and subarachnoid hemorrhages).

The data was collected from an individual survey sheet previously established and validated in the service.

Data entry and processing was performed using Microsoft Word 2010 software. Data was analyzed using SPSS version 20 software.

Results

At the end of our study, we collected 340 cases of head trauma out of 6984 CT scans performed, of which 3282 concerned the skull and the brain with a frequency of 10.36% (340/3282). of 22.14 years. The male dominated the study with a sex ratio of 2H / 1F. Pupils and students were the most affected socio-professional layer, ie 44.4% of cases. The most frequent aetiology was road accidents, ie 83.8% of cases. The signs or symptoms prompting the request for the CT scan were dominated by headache, which was found in 93.2% of cases. The time to complete the CT scan was between the 2nd and 6th hour after the patients were admitted to the ward. The CT scan result was normal in 57.1% of cases with a predominance of bone fractures (37.6%) followed by edema under the scalp (35.3%). Intracerebral lesions were dominated by oedemato-hemorrhagic contusions (6.5%) and peri-cerebral lesions dominated by extra dural and subdural hematomas (3.5%). There was 0.3% involvement of the facial mass associated with damage to the skull. The cost of the brain scan per patient was 45,000FCFA.

Table I: Distribution of patients according to the time taken to perform CT

TDM completion deadlines	Effectif	Pourcentage
Less than 2h	41	12,1
[2-6h]	173	50,9
] 6-24h]	126	37,1
Total	**340**	**100**

Table II: Distribution of patients according to the result of the CT scan.

TDM exam	Effective	Percentage
Normal	194	57,1
Pathological	146	42,9
Total	**340**	**100**

Table III: Distribution of patients according to the type of cranio-encephalic lesions

Lesions	Effective	Percentage
Bone lesions	128	37,6
Edema	120	35,3
Skin lesions	93	27,4
Peri-cerebral lesions	25	7,4
Brain damage	25	7,4
Association of cerebral and peri-cerebral lesions	09	2,6
Facial mass involvement	01	0,3

Table IV: Distribution of patients according to the different types of peri-cerebral lesions

TYPE OF PERI-CEREBRAL INJURY	Effective	Percentage
Extradural hematoma	12	3,5
Subdural hematoma	12	3,5
Meningeal hemorrhage	09	2,7
No lesions	307	90,3
Total	**340**	**100**

Table V: Distribution of patients according to the different types of brain injury

BRAIN INJURIES	Effective	Percentage
Intracerebral hematoma	04	1,2
Hemorrhagic contusion	20	5,9
Edema-hemorrhagic contusion	22	6,5
Ventricular haemorrhage	02	0,5
Cerebral edema	04	1,2
Commitment	03	0,9
No lesions	285	83,8
Total	**340**	**100**

Table VI: Relationship between the evacuation vector and the completion time CT

Evacuation vector	Time to perform CT			Total
	Less than 2h	2-6h	6-24h	
Medical ambulance	12	79	27	**118**
Civil protection vehicles	5	9	2	**16**
Personal vehicle	20	56	62	**138**
Public transport vehicle	4	29	35	**68**
Total	**41**	**173**	**126**	**340**

Fisher's exact test = 32,48 dof = 6 p-Fischer =0,000000

ICONOGRAPHY

Figure A: Brain CT in Volume Reconstruction showing bilateral frontal ballistic fracture features involving the roofs of the orbits and frontal sinuses

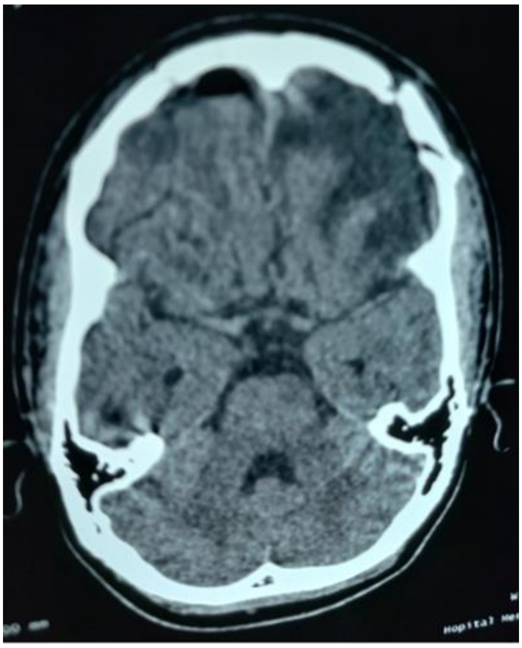

Figure B: Cerebral CT scan without injection in axial section showing chronic bi-frontal contusion foci opposite the fracture foci with right frontal pneumocephaly

Figure C: Axial CT scan without injection showing a fresh hematoma in a compressive right parietal biconvex lens on the cerebral parenchyma next to a focus of ipsilateral parietal fracture and subgaleal hematoma

There is also a subarachnoid hemorrhage

DISCUSSIONS

In our series, the CT scan for traumatic brain injury represented 10.36% of all scans performed. According to MASSON [4], traumatic brain injury accounts for a quarter of an estimated annual incidence of 281 new cases / 100,000 inhabitants.

The age less than or equal to 18 years represented 42.9% of cases, this is consistent with the results of the other series consulted: RICBOURG *et al*., [5] noted a significant peak in TCE in the age group of 15 -25 years and the age of 75 now represents a significant proportion and in particular for severe head trauma.

Furthermore, we noted that there was a significant relationship between age and type of accident with $p < 0.05$.

In our study, the male sex represented 70.3% of cases, ie a sex ratio of 2.36%. Our result is similar to that of MASSON [4] who reported a sex ratio of 3 men to 1 woman. This male predominance could be explained by the fact that men in most cases engage in activities that expose them more to traumatic brain injury than women. The occurrence of a head trauma far from the hospital and the absence of medical transport expose the injured to hypoxia, hypercapnia and hypovolemia, responsible for secondary lesions of the central nervous system, those which cause a significant death.

In our study, 81.1% of head trauma victims came from Bamako against 18.5% from outside Bamako. Unlike BEYE SA *et al*., [6] who reported that 73.9% of his injuries were of rural origin. This difference could be explained by the fact that the majority of large towns in the interior have scanners, thus reducing the flow of patients to the capital.

In our study, pupils and students were the most affected socio-professional layer, ie 44.4% of cases. Unlike BEYE SA *et al*., [6] who in their study reported that all socio-professional layers were affected. This could be explained by the recklessness and lack of civility of this layer.

In our study, 187 of our patients were literate, ie 55%. BEYE SA [6] et al reported 39.1% illiterate.

This could be explained by the negligence and incivism of drivers on the rules of the road.

In our series, 40.6% of our patients were transported by a personal vehicle; 4.7% of patients were brought in by civil protection vehicles and 34.6% were brought in by medical ambulances. Unlike in France, patient orientation and transport are provided by the emergency medical assistance service (SAMU) and the mobile emergency and resuscitation service (SMUR) whose objective is to stabilize vital functions. and stabilization of the lesions while awaiting arrival at the hospital. This contradiction can be explained by the absence in our structures of emergency aid services.

We noted that there is a relationship between the evacuation vector and the time elapsed before the CT scan was performed with p <10-4.

Road accidents are the main causes of craniocerebral trauma in all categories of severity.

In our study, road accidents represented 83.8% of the causes of craniocerebral trauma followed by domestic accidents with 8.8% of cases. These data are superimposable with those found by MASSON [4] which reported 62.6% of accidents on public roads and, unlike our study, 10.1% of falls. The condition of roads and vehicles, as well as incivism and speeding, are mainly blamed for the preponderance of road accidents in the aetiology of cranio-encephalic trauma. Domestic accidents were the second cause of assault and battery, they were the third cause of cranio-encephalic trauma in our study. These results could be explained on the one hand by the non-respect of the highway codes and on the other hand by the upsurge in banditry in our capital, which has been welcoming refugees from Central Africa and South Africa for several years. West and the displaced people from the north of the country.

Direct shock was the most frequent mechanism, at 87.6%. This could be explained by speeding, irresponsible behavior and the lack of helmet use by motorcyclists.

The neurological examination must be simple, codified and above all repeated, it must assess the state of consciousness, the pupillary state and the focused deficits.

In our series, the notion of initial loss of consciousness was noted in 101 patients, including 58 patients with abnormal CT and 43 patients with normal CT. There was one case of secondary loss of consciousness with normal CT, 10 cases of initial and secondary loss of consciousness including 2 patients with normal CT and 8 patients with abnormal CT. 228 patients presented with no notion of loss of consciousness of these 148 patients had normal CT and 80 patients abnormal CT. TIRET L *et al*., [7] found that 80% of patients were conscious after the trauma, 38.3% were obsessed and 9% comatose after the trauma.

The advent of the scanner in Mali in 1998 made it possible to better explore traumatic brain injuries and to provide good management. The CT scan was performed on all of our patients.

Based on the time taken to perform CT, 12.1% of our patients had CT before the 1st hour after the accident and 50.9% between the 06th and 12th hours after the accident. For the study by VAN HAVERBEKE *et al*., [8], a first brain CT examination was performed in 190 patients during the first 24 hours, ie 88.4% of cases. This early completion of the scanner in our study could be explained by the almost permanent availability of the imaging staff to perform the CT scan 24 hours a day at the Mother Child Hospital in Luxembourg and in addition to that of the device.

The cost of CT scans for these traumatic brain injuries during the study period represented 15,300,000 FCFA including 45,000 FCFA paid by each person. Compared to France, mild craniocerebral trauma alone costs France 17 billion dollars each year [2]. This could partly explain the delay observed in performing the CT scan in 50.9% of our patients.

During our various examinations we were able to make a classification of cranio-encephalic lesions.

Analytically, bone lesions of the vault of the skull occupied 1st place in our series (37.6%) followed fairly closely by edema (35.3%) and skin lesions (27.4%). The simple fracture of the cranial vault accounted for 29.4% of the lesions. VIGOUROUX [9] did not find a significant difference between fractures of the vault and the base of the skull. This is the violence of the shock.

In 0.3% of cases, facial tissue involvement was associated with the skull fracture, hence the need to explore the facial tissue and cervical spine during any CT scan for craniocerebral trauma and vice versa.

We noted 12 cases of extra and subdural hematoma, ie 3.5%. This result is superimposed on the 3% of extradural hematoma and 5.06% of subdural hematoma reported by ALAOUI [10].

Edema-hemorrhagic contusions and hemorrhagic contusions were the main lesions encountered in our series, ie 6.5%. This result is lower than that of S. GUIDAH *et al*., [11] who found 35.31% of hemorrhagic contusion. These lesions could be related to high speed trauma. They sit where the parenchyma has been violently thrown against a bony roughness. The classic tomodensitometric aspect is that of the spontaneously heterogeneous hyperdense area surrounded by hypodensity (edema), all intermediates are possible from the superficial contusion, or cortico-subcortical with the tomodensitometric aspect (pepper-salt aspect) up to 'to cerebral attrition where confluent hemorrhages result in hyperdense streaks with irregular contours, triangular in shape with a cortical base sinking' 'wedge' 'into the parenchyma. An intracerebral hematoma is an isolated, well-circumscribed blood collection located within the brain parenchyma. These intracerebral hematomas represented 1.2% of hemorrhagic lesions in our study. Diffuse cerebral edema constituted 1.2% of secondary intracranial lesions. On the CT plan, we noted a focal peri-lesional or diffuse hypodensity, indicative of localized or generalized cerebral edema. DANZE [12] noted that more than 50% of patients had cerebral edema. The presence of this sign is due in most of the time to violence and the mechanism of shock.

The association of cerebral and peri-cerebral lesions was less frequent in our series, ie 2.6% of cases.

In 0.3% of cases, the involvement of the facial mass was associated with the fracture of the skull, hence the need to explore the facial mass and the cervical spine during any CT examination for cranioencephalic trauma and vice. versa.

Conclusion

Traumatic brain injuries are now a frequently encountered emergency in Mali's health services. The CT scan is the primary examination of an emergency head trauma patient. It allows a better understanding of the different types of traumatic cranio-encephalic lesions, to specify their topography and their importance.

Integrating this data into pre, per and post therapy management helps improve patient survival. But the high cost of the scanner in our health facilities and the lack of an emergency aid service are factors that delay the urgent care of trauma patients.

Declaration of conflicts of interest: The authors declare no conflict of interest.

Contributions from the authors:

All authors contributed to data acquisition, data analysis and interpretation, and article writing.

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